UCRL-JC-123805 Abs

Using EPANET Water Quality Modeling to Make Design Decisions

Kathryn Mallon[1], Bonny Starr[1], Jill Farell[2]

[1] Montgomery Watson
[2] Lawrence Livermore National Laboratories

Over the past decade, distribution sys tem water quality has become an important issue for water utilities. Future regulations, such as the D/DBP Rule will further increase the importance of understanding your distribution system. During this project, the EPANET hydraulic model was found to be a powerful and cost effective tool for simulating water quality in a distribution system. The model was used to quickly evaluate compliance with the anticipated D/DBP Rule uder various treatment and operational scenarios.

The Lawrence Livermore National Laboratory (LLNL) operates a small, public water system serving approximately 300 daytime employees. The average annual water demand is approximately 30 million gallons (82,000 gpd) and the peak daily demand is approximately 270,000 gallons. Historically, the Site has relied on the underlying aquifer for its water supply. However, high TDS levels and groundwater contamination issues have forced LLNL to look for an alternative water supply. Recently, Site 300 contracted with the San Francisco Water Department (SFWD) to purchase potable water from the pristine Hetch Hetchy supply. Water received from SFWD does not meet the disinfection requirements of the Surface Water Treatment Rule due to the limited contact time between SFWD's point of chlorination and LLNL's turnout from the Aqueduct. Furthermore, the Hetch Hetchy water supply contains sufficient organic precursor material such that disinfection by-product (DBP) formation can exceed current and future maximum contaminant levels (MCLs) during the long detention times experienced in the Site 300 system. The objective of this study was to develop and evaluate various options that could be implemented at Site 300 such that all water quality and operational requirements could be achieved. The goal was to identify a method of achieving adequate CT under the SWTR while maintaining DBP levels throughout the distribution system below the anticipated Stage I MCLs for THMs and HAAs of 80 µg/L and 60 µg/L, respectively.

Several treatment options which were considered included the following:

- Boosting the chlorine dose at the aqueduct to increase disinfection
- Adding additional storage tanks at the turnout to increase disinfection contact time
- Modifying the existing system to increase disinfection contact time
- Provide filtration at the turnout to achieve adequate CT credit

In order to evaluate the impact of each of these options on the formation of disinfection by-products (DBPs) in the Site 300 distribution system, Montgomery Watson combined the results of laboratory DBP experiments with water quality simulations using EPANET hydraulic distribution system model. The laboratory experiments were used to determine the kinetics of DBP formation while the the EPANET model was used to evaluate hydraulic detention times in the distribution system. For instance, based on laboratory experiments, THM levels could be expected to exceed 80 µg/L in the distribution system after 4 days detention time. Hydraulic simulations were then run using the EPANET model to determine whether detention times in the distribution system exceeded 4 days under various system configurations. In several runs, tanks were added to increase the disinfection contact time while in other runs, the system was modified to use existing storage for additional contact time. Results of the model simulations were then used to screen out options which could not meet both the disinfection requirements of the SWTR and DBP MCLs of the anticipated D/DBP Rule.

*This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48.